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Typhoid Fever and Its Sequelae

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TYPHOID FEVER AND ITS SEQUELÆ.

Our problem in this study was to measure the effect of typhoid fever upon vitality during the first three years following recovery, and also to note the causes of death which predominate during this period.

Records Used.

For this purpose, we turned to the reports of the Visiting Nurse Service of the Metropolitan Life Insurance Company for the year 1911. In that year, 1,936 cases of typhoid fever were recorded. A fairly complete record of the illness in these cases was available. A further advantage in this series was the fact that the subsequent whereabouts and condition of those who were treated could be obtained from the insurance records. In this way, we could at once be informed with regard to the present status of these persons; whether they were living or dead, the date of death, as well as a complete record of the conditions at death in these later cases. It was, in other words, possible for us to trace this series fairly completely and to determine the consequences and effects of typhoid fever on these persons.

An examination of our 1,936 cases led to the elimination of 362 in which the record did not appear satisfactory from the point of view of accuracy of diagnosis. As a result, we had, after careful analysis, a residue of 1,574 cases. All of these presented satisfactory evidence, so far as such records alone could, that the patient had suffered from an attack of "typhoid fever" at the time of 1911 nursing. The cases were in the hands of physicians and nurses. The treatment of the disease in every case indicated typhoid fever. The duration of the service as well as the large number of visits made, all pointed conclusively that our series was well selected and sound. The average number of visits made per case by our Visiting Nurse Service to these patients was close to seventeen (16.85) and the duration of nursing was close to twenty-four (23.87) days.

Distribution by Age and Sex.

Table 1 shows the distribution of the 1,574 cases by age and sex. It will be noted at once that 70.3 per cent. of the total cases were under twenty years of age and that 34.1 per cent. were under ten years. This proportion is somewhat higher than that usually observed in other typhoid fever series. The explanation lies in the fact that our Visiting Nurse Service is more readily availed of by women and children. It is important also to remember this large incidence at the earlier ages in view of its bearing on our findings later with reference to the sequelæ.

TABLE 1.

DISTRIBUTION BY AGE AND SEX OF 1,574 CASES OF TYPHOID FEVER.

VISITING NURSE SERVICE, 1911, METROPOLITAN LIFE INSURANCE COMPANY.

Age period.	Males and females.		Males.	Females.
	Number.	Per cent.		
Under 10	536	34.1	251	285
10–19	570	36.2	254	316
20–29	230	14.6	85	145
30–39	114	7.2	35	79
40–49	81	5.2	23	58
50 and over	43	2.7	17	26
Total—all ages	1,574	100.0	665	909
Per cent. of total—by sex		100.0	42.3	57.7

LETHAL RATES.

Table 2 presents the lethal rate per 100 treated for each period. The least rate is that for the children under ten; the highest trustworthy rate is for the group 20–29 which was 13.91 per 100. At the higher ages there are too few exposed to make the rate dependable. For the entire series of 1,574 cases treated, the lethal rate was 9.28 per 100 treated. This figure is consistent with that of other series which vary slightly above and below a mean of 10 deaths per 100 cases treated.

TABLE 2.

LETHAL RATES PER 100 CASES TREATED FOR TYPHOID FEVER—CLASSIFIED BY AGE PERIOD.

VISITING NURSE SERVICE, 1911, METROPOLITAN LIFE INSURANCE COMPANY.

Age period.	Number treated.	Number died under treatment.	Lethal rate per 100 treated.
Under 10	536	36	6.72
10–19	570	45	7.89
20–29	230	32	13.91
30–39	114	12	10.53
40–49	81	13	16.05
50 and over	43	8	18.60
Total—all ages	1,574	146	9.28

Complications.

Table 3 shows the complications in these 146 cases. These are important in view of our interest in the sequelæ to be referred to later. Interest should be centered in the fact that over 15 per cent. involve intestinal perforation, hemorrhage, peritonitis and other similar conditions. Meningitis and pneumonia were present in 10.3 per cent. of the fatal cases, heart conditions in 8.2 per cent. of the cases. Other complications, such as tuberculosis and acute nephritis indicated that the lungs and kidneys were impaired in a considerable number of cases in connection with the typhoid infection.

TABLE 3.

COMPLICATIONS IN 146 FATAL CASES OF TYPHOID FEVER.

Visiting Nurse Service, 1911, Metropolitan Life Insurance Company.

Complications with typhoid fever.	Number of deaths.	Per cent. of total deaths.
No complications stated	60	41.1
Intestinal perforation, hemorrhage	22	15.1
Meningitis	15	10.3
Pneumonia	15	10.3
Heart involvements	12	8.2
Tuberculosis (all forms)	8	5.5
Acute nephritis	4	2.7
Other complications	10	6.8
Total fatal cases	146	100.0

Distribution of Recovered Cases.

Table 4 shows the distribution by age and sex of the 1,428 persons who recovered from the typhoid fever. This distribution is very slightly different from that of Table 1 which showed the distribution of the initial cases.

Relation Actual to Expected Mortality.

From this point onward, our effort was directed to a comparison of the actual and expected mortality among the 1,428 survivors. Our method was as follows: The 1,428 cases were distributed by sex and color and by ten-year age periods. A separate schedule was prepared for each sex and color. The mortality rates of the Company for each individual age. sex and color class was employed as a standard. We assumed that the mor-

TABLE 4.

DISTRIBUTION BY AGE AND SEX OF 1,428 PERSONS WHO RECOVERED FROM TYPHOID FEVER.

VISITING NURSE SERVICE, 1911, METROPOLITAN LIFE INSURANCE COMPANY.

Age period.	Males and females.		Males.	Females.
	Number.	Per cent.		
Under 10	500	35.0	239	261
10–19	525	36.8	232	293
20–29	198	13.9	68	130
30–39	102	7.1	30	72
40–49	68	4.8	14	54
50 and over	35	2.5	9	26
Total—all ages	1,428	100.0	592	836
Per cent. of total—by sex		100.0	41.5	58.5

tality actually experienced in 1911 by the Company in the Industrial Department should serve as the measure of the expected deaths for the corresponding group of these persons who had recovered from typhoid fever in 1911 for the first year after recovery. For the second year after recovery, we employed similar mortality figures for the year 1912 as a standard and for the third year we employed the figures for 1913. In other words, the mortality table used was not an arbitrary measure but exhibited the death-rates which persons of the same sex, color and age among our Industrial policyholders actually experienced. By throwing these rates into the number of years of life of each group in successive years since recovery we obtained the number of expected deaths for each age period.

In this way we found, as shown in Table 5, that in the series of 1,428 persons the expected number of deaths was equal to 26.45. As a matter of fact, our record showed 54 actual deaths. The ratio of actual to expected deaths was, therefore, for our entire series, 204 per cent. In other words, more than twice the mortality expected was realized. You will note that the total number of years of life was nearly 3,850 years.

A number of persons dropped out, either by death or lapsing their policies during the first, second or third year after recovery. Each such exit from our series involved an adjustment in the number of years of life exposed to risk, by taking the proportionate part of a year from the date of recovery to the date of exit. In this way, every day of experience was used. Fortunately, the fullness of the Company's record made this much desired

TABLE 5.

COMPARISON OF ACTUAL AND EXPECTED MORTALITY IN THREE YEARS FOLLOWING RECOVERY FROM TYPHOID FEVER—CLASSIFIED BY AGE PERIOD.

CASES TREATED BY VISITING NURSE SERVICE, 1911, METROPOLITAN LIFE INSURANCE COMPANY.

Age period.	Number of years of life.	Number of expected deaths.	Number of actual deaths.	Per cent. actual of expected deaths.
Under 10.....	1,354.15	8.07	13	161
10–19.....	1,434.66	5.61	12	214
20–29.....	521.27	3.92	13	332
30–39.....	274.16	2.94	5	170
40–49.....	173.05	2.46	8	325
50 and over.....	92.62	3.45	3	87
Total—all ages....	3,849.91	26.45	54	204

step possible. It would be difficult in many other services to keep such complete control of the whereabouts of the individuals composing a large series. Our conclusion from our own series is, therefore, that during the first three years after recovery from typhoid fever, the mortality is twice the normal.

It is interesting to note, however, that this increased rate is not uniformly evident in all the three years of the series. Thus, in the first year following recovery from typhoid fever the ratio of actual to expected deaths was 284, in other words nearly three times as great as it should be. In the second year, the percentage actual of expected deaths was 217, and in the third year it fell below the expected, namely to 80 actual deaths per 100 expected deaths. This last fact is puzzling. A careful reëxamination was made of our series. No effort was spared in finding a possible source of error and yet at the very end, we find no evidence of an additional death which would in any way change our figure.

It would appear from our figures that typhoid fever has its impairing effect in the first two years after recovery. It would seem, although we would not press this explanation, that the weaklings had been eliminated by the immediate deaths and those that followed in the first two years after recovery. Table 7 shows the causes of death in the 54 cases that occurred in the three years subsequent to recovery. Tuberculosis heads the list with twenty-one deaths (39 per cent.), of which all but three cases were of the pulmonary type. The second important group are the diseases of the heart with a total of eight cases. Pneumonia, and kidney disease follow with four cases each.

TABLE 6.

COMPARISON OF ACTUAL AND EXPECTED MORTALITY IN EACH OF THREE YEARS FOLLOWING RECOVERY FROM TYPHOID FEVER—CLASSIFIED BY AGE PERIOD.

CASES TREATED BY VISITING NURSE SERVICE, 1911, METROPOLITAN LIFE INSURANCE COMPANY.

Age period.	First year after recovery.			Second year after recovery.			Third year after recovery.		
	Number of		Per cent. actual of expected deaths.	Number of		Per cent. actual of expected deaths.	Number of		Per cent. actual of expected deaths.
	Expected deaths.	Actual deaths.		Expected deaths.	Actual deaths.		Expected deaths.	Actual deaths.	
Under 10	3.73	4	107.	2.54	5	236.	1.80	3	167
10–19	1.86	8	430.	1.91	4	209.	1.84	....	....
20–29	1.45	3	207.	1.31	7	534.	1.16	3	259
30–39	1.06	5	472.	1.00	....	....	.88	....	....
40–49	.88	7	795.	.82	1	122.	.76	....	....
50 and over	1.24	2	161.	1.16	1	86.	1.05	....	....
Total—all ages	10.22	29	284.	8.74	19	217.	7.49	6	80

Our conclusion, then, from this table is that the incidences of tuberculosis and the diseases of the heart are increased subsequent to typhoid fever. This is borne out by the previous statement of complications which occurred in the immediate deaths, Table 3, where a considerable number of cases showed heart and pulmonary complications. This condition has been noted consistently by other observers of typhoid fever and its sequelæ.

Effect of Sequelæ upon General Death Rate.

We will close this paper with an estimate of the effect of typhoid fever upon mortality in the three years subsequent to an attack. On the basis of the estimated population of Continental United States in 1914, we have calculated that each year a minimum of close to 8,000 deaths occur which can be attributed annually to the impairments which follow typhoid fever. In this estimate, we have assumed a minimal death-rate from typhoid fever of 20 per 100,000. We have also assumed the number of cases to be ten times as great as the number of deaths in accordance with the usual practice. The number of recoveries, therefore, is 90 per cent. of the cases. For each of the three years following, we have assumed an expected death-rate for the entire country to be at least 15 per 1,000 from all causes. A calculation of the additional deaths due to sequelæ of typhoid fever gives us a

TABLE 7.

CAUSES OF 54 DEATHS IN THREE YEARS FOLLOWING RECOVERY AMONG 1,428 CASES OF TYPHOID FEVER.

Treated By Visiting Nurse Service, 1911, Metropolitan Life Insurance Company.

Cause of death.	Number of deaths.	Per cent. of total deaths.
Tuberculosis:		
Pulmonary	18	33.3
Other forms	3	5.6
Diseases of the heart:		
Endocarditis	4	7.4
Myocarditis	2	3.7
Valvular disease of the heart	2	3.7
Pneumonia	4	7.4
Nephritis:		
Acute	1	1.9
Bright's disease	3	5.6
Acute articular rheumatism	2	3.7
Violent causes	7	13.0
Other causes	8	14.8
Total—all causes	54	100.0

total of 7,781. This is the price that is paid annually over and above the registered direct loss from typhoid fever according to the results of our study. It is not only the 20,000 immediate deaths that we have to consider, but the additional 8,000 who, although recovered, cannot survive the strain which modern industrial life makes necessary and who either because of tubercular or cardiac lesions die untimely deaths within the first or the second year after recovery.

TABLE 8.

ESTIMATED NUMBER OF DEATHS TO BE ATTRIBUTED ANNUALLY TO SEQUELÆ OF TYPHOID FEVER IN THE UNITED STATES.

Population, Continental United States, 1914	98,781,324
TYPHOID FEVER:	
Death rate per 100,000, Continental United States, 1914 (minimal estimate)	20
Deaths in United States in 1914	19,800
Cases in United States in 1914	198,000
Recoveries, each year, in United States	178,200
Extra deaths to be attributed annually to sequelæ of *typhoid fever*. (On basis of double mortality in three years following recovery)	7,781

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